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ABSTRACT

This study explored the importance of group interaction for learning. It investigated: (1) the relationship between group interaction and achievement, and whether this relationship was constant across ability levels; and (2) the importance of ability, extroversion-introversion, and group composition as predictors of group interaction. The sample consisted of 96 students in grades 7, 8, and 9 from two average and two above-average general mathematics classes. The topic of the instructional materials was consumer mathematics. Instrumentation used in the study consisted of an achievement test, personality measure, and an observation instrument. The analysis of achievement, interaction in the group, and student and group characteristics revealed three important findings. First, asking a question and receiving no answer was the predominant group interaction variable predicting achievement, with receiving no answers detrimental. Second, the amount of time spent working with other students influenced achievement, but the relationship differed across ability levels. Working with others was beneficial for low ability students but somewhat detrimental for high ability students. Third, the interaction variable asking a question and receiving no answer was predicted from group composition and extroversion-introversion, suggesting that group interaction mediates the effects of some individual and group characteristics on achievement. Further studies with carefully defined combinations of group composition, ability, personality, interaction, and achievement are suggested. (MP)

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PERSONALITY AND ABILITY CORRELATES OF GROUP INTERACTION AND ACHIEVEMENT IN SMALL GROUPS

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Personality and Ability Correlates of Group Interaction
and Achievement in Small Groups

The past few years have seen a dramatic resurgence of research on learning in cooperative groups. Most of this research shows advantages of cooperative settings over competitive or individualistic settings (see reviews by Sharan, 1980; Slavin, 1980a,b). Little of this research, however, has systematically examined the interactional processes which relate to achievement in group settings.

The results of the few studies that have investigated students' roles in group interaction and related these roles to achievement suggest that interaction may be a key predictor of achievement. In one study, better performance was associated with active participation in the group (Webb, 1980a,b, Note 1). Students who gave or received explanations of how to complete the task scored higher than did students who did not actively engage in group interaction. Peterson and Janicki (1979) studying learning in small and large group classroom settings, also found that students benefited from teaching their peers. But the recipients of the explanations did not benefit. Whereas the above studies used total scores on achievement tests, another study focused on a specific problem in a more intensive analysis of group interaction (Webb, 1980c). In that study, receiving an explanation about the problem was highly correlated with test scores on that problem.

Not only are the Webb and Peterson-Janicki studies among the few that systematically related group interaction to achievement, they are among the few that related group interaction to characteristics of the student or of the group. Student ability was the predominant predictor of interaction in the group. Ability was positively related to helping behavior (giving

descriptions, giving explanations) in most studies (Peterson & Janicki, 1979; Webb, 1980d), but negatively related to receiving help only in some studies (Webb, 1980d). Complicating the picture further, group interaction was sometimes explained by an interaction of ability and group composition (Webb, 1980a,b, Note 1). High-ability students helped low-ability students in mixed-ability groups, and participated less in uniform-ability groups; medium-ability students, ignored in mixed-ability group interaction, actively helped one another in uniform-ability groups.

The present study explored further the importance of group interaction for learning. It investigated (1) the relationship between group interaction and achievement, and whether this relationship was constant across ability levels, and (2) the importance of ability, extroversion-introversion (see Hare, 1976) and group composition as predictors of group interaction.

Method

Sample

The sample consisted of 96 students in grades 7, 8, and 9. The students came from two average and two above-average general mathematics classes at a junior high school in the Los Angeles metropolitan area. Average mathematics and reading stanine scores of the Comprehensive Test of Basic Skills (CTBS) ranged from 3 to 9 in this sample. Approximately 40 percent of the students in these classes were minority. Because the mathematics classes at the school are tracked by ability rather than by grade, each class had students from all three grades. One volunteer teacher taught two average classes; the other volunteer teacher taught two above-average classes.

Instructional Materials

The topic of the instructional materials was consumer mathematics. The unit on consumer mathematics consisted of four activities, each completed on a different day. The activities were (1) "Restaurant Rendezvous"--reading menu prices, calculating tip and tax; (2) "Meals at Home"--calculating the costs of meals at home using grocery store prices and amounts; (3) "Clothing"--ordering clothing from a catalogue, calculating sales tax; and (4) "Checking Accounts"--balancing a checkbook, calculating the amount of a deposit less cash received.

To enable the groups to check their answers to the questions in the activities and to provide clues for solving the problems, all groups had access to answer sheets.

Instrumentation

Achievement test. The achievement test consisted of one multiple-part item corresponding to each activity in the unit. Credit was given for a part of an item if the answer was calculated correctly from earlier answers given; therefore, the accuracy of one part of an item did not depend on the accuracy of another part. The scale of the test ranged from 0 to 40 points. Internal consistency α for the achievement test was .81.

Personality measure. Students completed the extroversion-introversion scale of the Eysenck Personality Inventory (Eysenck & Eysenck, 1968). High scores (maximum of 24) are indicative of extroversion. For this sample, internal consistency α for the extroversion-introversion scale was .56.

Observation instrument. The observation instrument was designed to assess interaction among students in a group and interaction between the teacher and students. Each observer wrote notes about all interaction in the group, noting the speaker and recipient of each interchange, the observation category, and, whenever possible, the content of the interchange. From her own set of written notes, each observer made a tally of the number of occurrences of each observation category except students works alone and student works with others. These two observation categories were coded in terms of the number of minutes, rather than as frequencies. To assess the generalizability of the observations, a generalizability study (Cronbach, Gleser, Nanda, & Rajaratnam, 1972) was conducted in which two observers observed the groups simultaneously on two days. The observation categories and their estimated generalizability coefficients (ρ^2) for one observer and four days were: students gives help, $\rho^2 = .86$; student receive help, $\rho^2 = .67$; student asks a question, $\rho^2 = .97$; student asks a question and receives a response, $\rho^2 = .80$; student asks a question and

receives no response, $\rho^2 = .91$; student works alone, $\rho^2 = .82$; student works with others (task-related, nonspecific), $\rho^2 = .87$; and student is off task, $\rho^2 = .80$. These coefficients were judged to be high enough that one observer observing a group at any one time was sufficient.

To determine whether different raters might score one set of notes differently, a generalizability study was conducted in which two observers scored the notes made by one of the observers on five days. The estimated generalizability coefficients for one scorer ranged from .83 to .92, indicating that one scorer was sufficient.

Procedure

Determination of group composition. Group composition was determined on the basis of ability. The ability measure used in this study was the mean of the mathematics and reading stanine scores of the Comprehensive Test of Basic Skills (CTBS). Three ability strata were defined--high, medium, and low--corresponding approximately to the top 25%, the middle 50%, and the bottom 25% of the sample. Uniform-ability groups had students from the same ability stratum. Mixed-ability groups had students from more than one ability strata[1]. Half of the groups were uniform; half were mixed. Because the mean of the sample was above-average (mean stanine score = 6.3), students were low or medium relative to the sample, not in absolute terms.

Because the classes were tracked by ability, the two average classes consisted primarily of medium-ability and low-ability students, and the two above-average classes consisted of medium-ability and high-ability students. Consequently, mixed-ability groups had either medium-ability and low-ability students or high-ability and medium-ability students. No group could have high-ability and low-ability students. Most groups had four students; some had three.

Classroom activities. On the first day, students received their group assignments and their schedule of activities for the week. Activities were assigned to groups according to a Latin Square design so that groups worked on activities on different days during the week.

Students were told to work together and not to divide the work, to help group members experiencing difficulty and to ask for help if they needed it. They were instructed to check the answer sheet or ask the teacher for help only if no one in the group could solve the problem. To further promote cooperation among group members, groups participated in an intergroup competition: each group's score was the average of the test scores in the group. The group with the highest score received a prize. The reward structure was, therefore, intergroup competition-intragroup cooperation (see Michaels, 1977); groups competed for rewards but group rewards were distributed equally within each group. Deutsch (1949, 1960) found that this reward structure promoted cooperation, helpfulness, and coordination of efforts among group members.

During group work, students in a group worked on one set of materials. The teacher monitored group work by answering questions, by providing hints when groups could not proceed, and by ensuring that students worked on the task and did not bother other groups.

Each group was observed for approximately seven minutes during each class period. The order in which groups were observed was counterbalanced (using a Latin Square design) so that each group was observed at different times during the class period. Because the observers had visited the classes on previous occasions to familiarize the students with their presence, most students ignored them. Occasionally, students asked the observers for help; the observers directed them to the teacher.

Assessment. During the week after small-group work, students completed the achievement test and the questionnaire. Students worked individually on the test and on the questionnaire.

Results

Correlates of Achievement

Table 1 presents the correlations among achievement, observation variables, ability, personality, and group composition. The interaction variable most strongly related to achievement was asking a question and receiving no response. Students who did not receive answers to their questions obtained lower test scores than students who did receive answers to their questions. The only other interaction variable significantly related to achievement, asking a question and receiving a response, did not predict achievement over and above asking a question and receiving no response in a stepwise multiple regression analysis ($F = 1.19$, $df = 1,93$, $p < .30$, increment in $R^2 < .01$).

Table 1 about here

To determine whether the relationships between observation variables and achievement differed across ability levels, a multiple regression analysis of achievement was performed which included as predictors each observation variable and the interaction between each observation variable and ability. From this analysis emerged one important interaction effect: the interaction between working with other students (nonspecific) and ability. Nonspecific working with others included sharing answers, checking work, and working out the solution to a problem with other students; it excluded giving help, receiving help, and asking questions. Table 2 presents the results of the multiple regression analysis summarizing the major predictors of achievement, and including characteristics of the student and of the group. The observation variable "asks a question, receives no response", student ability, and the interaction between ability and "works with others" were statistically significant predictors of achievement. These variables together accounted for 51 percent of the variance in achievement test scores.

Table 2 about here

To explicate the effect of the interaction between working with others and ability on achievement, a regression analysis predicting achievement from working together was performed within each ability level. The regression coefficients are presented in Table 3 and the graph of the relationships between working with others and achievement is shown in Figure 1. A test of the heterogeneity of the regression slopes was statistically significant ($F = 5.51$, $df = 2,90$; $MS_e = 48.42$, $p < .01$). Low-ability students who spent much of the class time working with other students (nonspecific) achieved more than did low-ability students who spent little class time working with other students. High-ability students in contrast, tended to achieve more when they worked less with other students (the regression coefficient was marginally significant, $p < .08$). For medium-ability students, the amount of time spent working with other students did not influence achievement.

Table 3 and Figure 1 about here

A question that emerges from the pattern of relationships between working with others and achievement is whether this pattern can be reinterpreted in terms of time spent working alone, an observation variable substantially correlated with working with others ($r = -.48$). The results of regression analyses within ability levels of achievement predicted from working alone are presented in Table 4 and Figure 2. For low-ability students, as predicted from the relationship between working with others and achievement, those who spent much of class time working alone obtained lower achievement scores than did those who spent little class time working along. Also as predicted, working alone did not relate to achievement among medium-ability

students. For high-ability students, however, the expected positive relationship between working alone and achievement did not appear; working alone did not relate to achievement. The regression coefficients within ability level are significantly different ($F = 3.42$, $df = 2,90$, $MS_e = 50.93$, $p < .05$).

Table 4 and Figure 2 about here

Correlates of Group Interaction

Of the student and group characteristics used to predict achievement, only student ability was a significant predictor (see Table 2). To determine whether any student or group characteristic related to achievement indirectly, through group interaction, multiple regression analyses were performed predicting "asks a question and receives no answer" and ability x "works with another student" from ability, extroversion-introversion, and group composition. The results of the multiple regression analyses are presented in Table 5. For "asks a question, receives no answer" group composition was a significant predictor, extroversion-introversion was a marginally significant predictor ($p < .08$), and ability was not a significant predictor. Students in uniform-ability groups received no answers to their questions more often than students in mixed-ability groups did, and introverted students received no answers to their questions more often than extroverted students did. For the interaction between ability and works with others, no student or group characteristic was a significant predictor.

Table 5 about here

Discussion

The analyses of achievement, interaction in the group, and student and group characteristics revealed three important findings. First, asking a question and receiving no answer was the predominant group interaction variable predicting achievement. Receiving no answers to questions was detrimental to achievement. Second, another interaction variable, the amount of time spent working with other students (not specifically helping others, receiving help, or asking questions), influenced achievement, but the relationship differed across ability levels. For low-ability students, working with others was beneficial for achievement; for high-ability students, working with others was somewhat detrimental to achievement; and for medium-ability students, working with others had no effect on achievement. Third, the interaction variable asking a question and receiving no answer was predicted from group composition (more frequent in uniform-ability groups) and extroversion-introversion (more frequent among introverted students), suggesting that group interaction mediates the effects of some individual and group characteristics on achievement.

The importance for learning of receiving answers to questions agrees with the finding by Webb (1980c) that students who had difficulty (made errors, asked questions) learned the material only if they received explanations. Without receiving responses to their questions, students were not able to correct their misunderstandings or lack of understanding of the task.

The finding of an interaction between working with others and ability of the student and the complementary results for working alone--low-ability students did better when they spent more of their time working with other students than working alone, whereas high-ability students tended to do better when working with others less of the time--is intuitively reasonable.

Low-ability students may not have had the skills or conceptual understanding to learn the material without input from others. High-ability and medium-ability students, on the other hand, may not have needed to rely on input from others to clarify the material. More detailed information on the nature of "working with others" is needed to clarify how this interaction event helped low-ability studetns to learn the material. In any case, the finding of an interaction suggests that the experiences beneficial for learning in small groups may not be the same at all ability levels, and that future studies should consider this possible result.

The higher frequency of answering members' questions in mixed-ability groups than in uniform-ability groups may have been due to a recognition of the range of ability in the group and a sense of responsibility toward low-ability gorup members. Post-experimental interview data would help clarify this hypothesis.

The tendency of introverted students to fail to obtain answers to their questions more often than extroverted students did is consistent with the literature finding positive correlations between interpersonal behavior in groups and scales that measure dominance, aggressiveness, and extroversion (Aronson & Weintraub, 1967; Gold, DeLeon, & Swensen, 1966; Hare, 1976; Leader, 1973; Lerea & Goldberg, 1961; Moerk, 1972; Sales, 1971; Stern & Grosz, 1966; Wagoner & Grosz, 1971). In the absence of direct observations, however, the result in the present study cannot be explained further.

It should be noted that the relationships established in this study apply to the variables as defined here and for the content examined here. The interaction variables important for achievement might depend on the content area. Giving help, receiving help, and being off-task related to achievement in studies examining fractions, probability, and algebra

(Peterson & Janicki, 1979; Webb, 1980a,b,c, Note 1), but not in the present study examining general mathematics skills. Furthermore, the relationship between group composition and interaction may depend on the rule for allocating students to groups. When mixed-ability groups had high- and medium-ability students or medium- and low-ability students (the present study), ignoring students' questions occurred more frequently in uniform-ability groups than in mixed-ability groups. When mixed-ability groups had one high, one low and two mediums (Webb, 1980a,b, Note 1), medium ability students were ignored in mixed ability groups. Further studies with carefully defined combinations of group composition, ability, personality, interaction, and achievement are needed to establish general links among these variables.

Reference Notes

1. Webb, N. M. Learning in individual and group settings. Paper presented at the annual meeting of the American Educational Research Association, San Francisco, April 1979.

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Footnotes

[1]In some groups all students except one came from the same ability stratum. To determine whether these groups were uniform or mixed, the following decision rules were applied. A group was defined as mixed if the standard deviation of ability within the group was greater than 1.00. If the standard deviation was less than 1.00, the group was defined as uniform for the three students from the same ability stratum, and was defined as mixed for the one student from the different ability stratum.

[2]Approximately 10% of the students were absent when the extroversion-introversion scale was administered. Absentees came from all ability levels and were evenly distributed across types of grouping. Because missing scores were not related to any of the variables in the study, they were replaced by the mean of the sample.

Table 1

Correlations Among Achievement, Observation Variables, Ability, Extroversion-Introversion, and Group Composition

Variable	1	2	3	4	5	6	7	8	9	10	11	12
1. Achievement	--											
2. Gives help	.11	--										
3. Receives help	.05	-.12	--									
4. Asks question	-.15	-.17	.53**	--								
5. Asks question, receives response	.19*	-.04	.49**	.80**	--							
6. Asks question, receives no response	-.54**	-.21*	.14	.44**	-.18*	--						
7. Works alone	-.02	-.20*	-.26**	-.19*	-.22*	.02	--					
8. Works with others (nonspecific)	.06	.10	-.19*	-.22*	-.06	-.28**	-.48**	--				
9. Is off-task	-.15	-.04	-.03	-.10	-.15	.06	-.28**	.00	--			
10. Ability	.52**	.13	.20*	.03	.12	-.14	-.12	.03	-.06	--		
11. Extroversion-introversion	.14	.09	.19*	.07	.17	-.14	-.17	.10	.02	.08	--	
12. Group composition[a]	.16	.02	-.13	-.14	.10	.37**	-.10	.20*	-.07	-.07	-.12	--

[a]Group composition is coded: 1 = uniform-ability, 2 = mixed-ability,

*$p < .05$

**$p < .01$

Table 2

Summary of Multiple Regression Analysis of Achievement

Predictor	b	F	R^2
Full model	--	16.08**	.52
Observation variables			
Asks question, receives no answer	-3.87	30.21**	.29
Works with others (nonspecific)	.80	2.97	.01
Student and Group Characteristics			
Ability	4.44	21.85**	.20
Extroversion-introversion	.14	.30	.00
Group composition	.48	.12	.00
Works with others x Ability	-.14	4.20*	.02

*$p < .05$

**$p < .01$

Table 3

Regression of Achievement on Time Spent Working with Others Within Each Ability Level

Ability level	n	b	Standard error b	F
High	25	-.40	.21	3.5
Medium	50	.11	.14	0.61
Low	21	.73	.25	8.21**

** $p < .01$

Table 4

Regression of Achievement on Time Spent Working Alone Within Each Ability Level

Ability level	n	b	Standard error b	F
High	25	.18	.19	0.86
Medium	50	.16	.19	0.76
Low	21	-.48	.21	5.00*

* $p < .05$

Table 5

Multiple Regression Analyses of Observation Variables on Student and Group Characteristics

Predictor	Asks question, receives no answer			Ability x Works with others		
	b	R^2	F	b	R^2	F
Group composition	-.82	.14	18.08**	14.29	.02	2.19
Extroversion-introversion	-.07	.03	3.32	2.26	.01	1.36
Ability	.11	.02	2.60	--	--	--

*$p < .05$

**$p < .01$

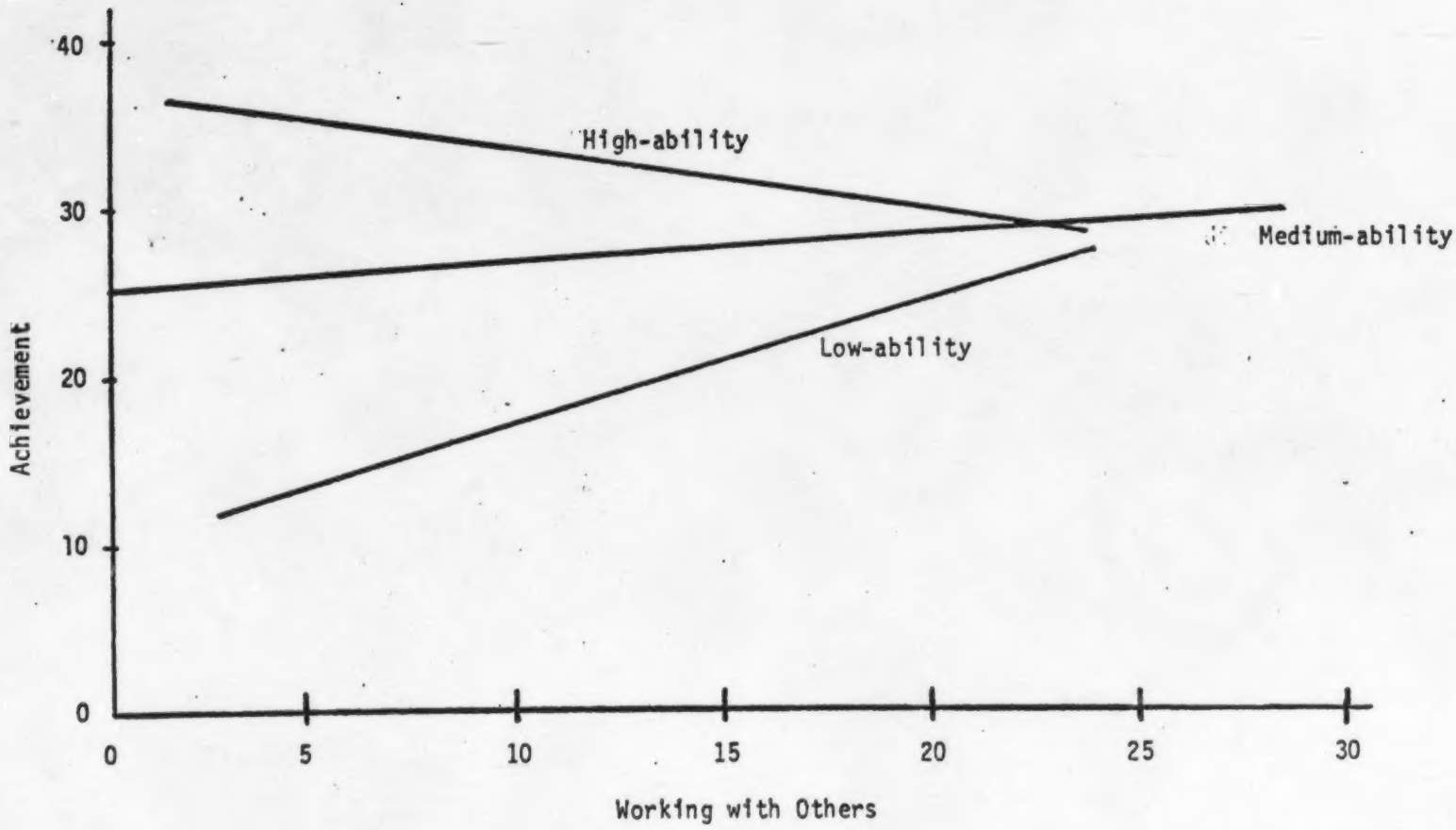

Figure 1. Regressions of Achievement on Time Spent Working with Others Within Ability Level

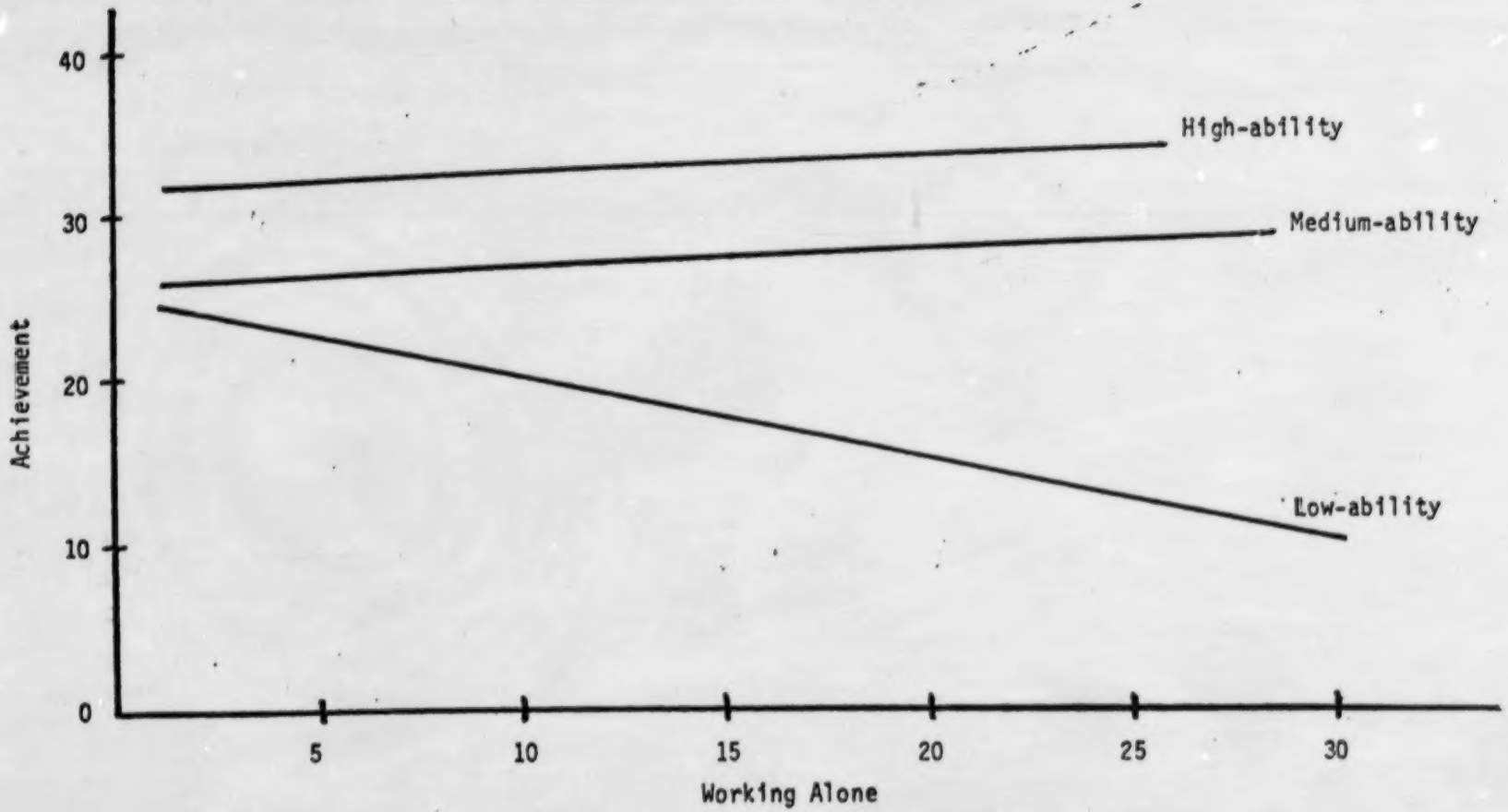

Figure 2. Regressions of Achievement on Time Spent Working Alone Within Ability Level